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STRUCTURE OF THE BONE OF DINICHTHYS.

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The remarkable mail-clad fishes of the old red sandstone of Scotland brought to notice by Hugh Miller gave us our first knowledge of the ichthyic fauna of the Upper Devonian rocks. Similar remains soon afterward came to light from other countries of Europe, but until recently our knowledge of any corresponding fauna from this country was limited to a few detached and broken plates described from New York and Pennsylvania.

The discoveries of Mr. Terrell and of Dr. Clark in the Cleveland shale of Ohio have, however, now revealed to us the existence of fossil monsters equaling or rivaling those of Europe. Among these *Dinichthys* was the earliest, and has therefore naturally attracted to itself the most attention. Several species are now known from Ohio, and others from contemporaneous rocks elsewhere. The species are for the most part characterized by their jaws, these being the parts most frequently found and generally the best preserved.

The dentition of some of the species of *Dinichthys* was very remarkable and, indeed, unexampled in the animal kingdom. In none of them did the lower jaw carry any separate teeth, but its upper edge was modified in all to serve as a cutting or biting instrument. In several species, of which *D. Terrelli* may be taken as a type, behind the strong roundly triangular tooth formed by the upturning of the front end of the lower jaw the superior margin terminates in a long sharp edge like one of the blades of a pair of scissors or shears. Against and outside of this fitted a similar cutting edge or tooth in the upper jaw. This last, however, was not the maxillary bone itself, but was set into it.

There was no means of renewing this blade, for it is not at all probable, judging from its structure, that any growth took place after maturity was reached. It was kept sharp by use and wear.

Posteriorly the jaw thins down to a spatulate ending, which was doubtless buried in a mass of muscle or cartilage, but its connection with the upper jaw—its suspension—is as yet undetermined.

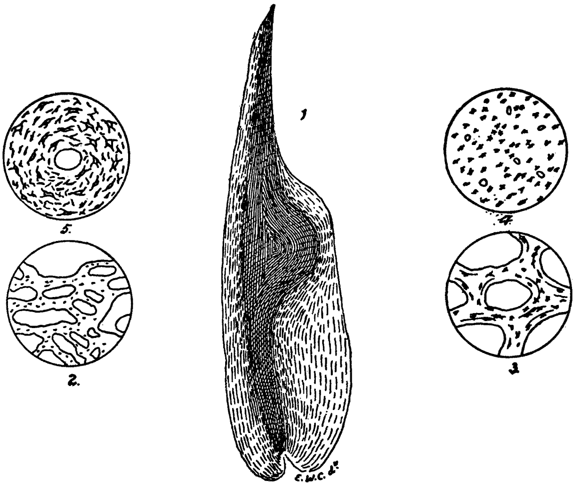
The structure of this singular mandible is the subject of the present paper. As will be well understood, when specimens are rare and only attained at the cost of much time and labor, it is not easy to secure one for microscopic study. No one is disposed to sacrifice a good fossil for the purpose. Moreover, only two or three persons have them to give. Add to this the fact that all are pyritized and of course, so far as this mineral is concerned, absolutely opaque, and we can see that the microscopic study of this jaw is not easy. Fortunately, however, in Dr. Clark's possession was a fragment which he had one day picked up showing only the anterior part of a jaw of *D. intermedius*. It had been broken almost square across before it was found. This being of little value as a specimen and being, moreover, exactly suited to my purpose, he put it at my disposal and I was thus enabled to accomplish my purpose.

I first ground down and polished its broken face, and from this was able to distinguish the internal structure on the large scale, and some chips of the different materials supplied the details.

The jawbone does not essentially differ in structure from the rest of the bones of *Dinichthys* except that it is perhaps a little more solid, nor does it present any striking difference in appearance from some other kinds of bone from rocks of similar age. In general the arrangement is the same as that of recent bone. The Haversian canals are large and the osseous tissue shows slightly the concentric lamination of true bone, while scattered through the mass are abundant "lacunæ" or "osteoblasts," showing little or no regularity in their arrangement. From these "lacunæ" project a few canalicules, seldom more than three or four being visible. Beyond this no further structure could be made out. The radiate arrangement of canalicules running from the Haversian canals to the "lacunæ" and often inosculating is either absent or invisible.

But the internal part of the jaw consists of very different material. As shown in the figure, it has a much denser texture and greater hardness. It is thickest in the middle of the jaw, thinning away toward the top and bottom, though it is continuous upward through the blade, where the outer bony coating becomes thinner. At the top it forms on the inside the actual cutting edge. This was kept sharp by the friction of the upper tooth, which maintained an edge beveled on the outer side, as shown.

The microscopic examination of a thin slice of this dense tissue shows a structure represented in Fig. 4. The Haversian canals are reduced to a very small size and appear quite insignificant in the section; but the solid tissue of the bone has proportionately increased and forms almost a solid mass, scattered through which are the "lacunæ," with their branching canalicules, as described in the former tissue and as shown on a larger scale in Fig. 5.



Dinichthys Terrelli — Section of Mandible

I need not point out the absence of enamel, because this is not present except in very rare cases, in either fossil or recent fishes; but it is worthy of notice that the tooth shows no trace of dentine, which is so conspicuous in the teeth of existing sharks, etc., nor is there any resemblance to osteodentine or ivory, as in the teeth of the whales, etc. The tubular structure of these two materials is totally wanting here. The whole organ, jaw and teeth, if rightly so called, is made of bone, and apparently all the modifications of bone had not been evolved in the days of *Dinichthys*. It is bone of a peculiarly dense and compact form, but devoid of any abnormal features.